

Applicant : S. R. Narayanan, et al.
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REMARKS

Claims 18-27 and 29-31 are pending in this application. Claims 11-17 and 28 are canceled herein. Claim 18 is written as an independent claim as suggested in the Office Action. Claims 19, 26 and 27 are amended herein. Basis for the amendments can be found in the application as originally filed. No new matter is added.

THE REJECTION OF CLAIMS 11-17 UNDER 35 U.S.C. §112, FIRST PARAGRAPH

The Office Action alleges that claims 11-17 under 35 U.S.C. §112, first paragraph, for lack of enablement. Claims 11-17 are canceled herein, thereby rendering the objection moot.

THE REJECTION OF CLAIMS 11, 12, 14, 15, 17, 19-23, and 25 UNDER 35 U.S.C. §102(e)

The Office Action alleges that claims 11, 12, 14, 15, 17, 19-23, and 25 are anticipated by Cabasso *et al.* (U.S. Patent No. 5,783,325). The Office Action alleges that the cited reference discloses a catalyst ink for gas diffusion electrode containing a catalytic material, a membrane plasticizer, and poly(vinylidene fluoride). It is alleged, with respect to claims 19-22 and 25, that Cabasso *et al.* teaches applying catalyst ink to the membrane. The Office Action urges that Cabasso *et al.* teaches an electrode containing the catalyst ink and bonding the catalyst side of the electrode to a Nafion membrane via a hot-pressing step. The Office Action concludes that the catalyst ink is applied to the membrane, and the membrane is bonded to the catalyst ink side of the electrode via-pressing step.

RELEVANT LAW

Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration. *In re Spada*, 15 USPQ2d 1655 (Fed. Cir. 1990), *In re Bond*, 15 USPQ 1566 (Fed. Cir. 1990), *Soundsciber Corp. v. U.S.*, 360 F.2d 954, 148 USPQ 298, 301, adopted 149 USPQ 640 (Ct. Cl.) 1966. See, also, *Richardson v. Suzulid Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913,1920 (Fed. Cir.), *cert. denied*, 110 S.Ct. 154 (1989). "[A]ll limitations in the claims must be found in the reference, since the claims measure the invention". *In re Lang*, 644 F.2d 856, 862, 209 USPQ 288, 293 (CCPA 1981). Moreover it is incumbent on the Examiner to identify wherein each and every facet of the claimed invention is disclosed in the reference. *Lindemann Maschinen-fabrik GmbH v. American Hoist and Derrick Co.*, 730 F.2d 1452, 221 USPQ 481 (Fed. Cir. 1984). Further, the reference must describe the invention as

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claimed sufficiently to have placed a person of ordinary skill in the art in possession of the invention. An inherent property has to flow naturally from what is taught in a reference *In re Oelrich*, 666 F.2d 578, 581, 212 USPQ 323, 326 (CCPA 1981).

Claims 11, 12, 14, 15 and 17

Please note that claims 11, 12, 14, 15 and 17 are canceled herein, thereby rendering the rejection moot.

Claims 19-22 and 25

Claim 19 is an independent claim and recites:

A process for making a membrane electrode assembly for a fuel cell, comprising:
(a) providing a catalyst ink comprising a catalytic material, and poly(vinylidene fluoride);
(b) applying the catalyst ink to at least one side of a PSSA-PVDF membrane;
and
(c) bonding the membrane to at least one electrode.

Claims 20-22 and 25 depend from claim 19 and further define the process.

Disclosure of Cabasso *et al.*

The cited reference by Cabasso *et al.* discloses gas diffusion electrodes for fuel cells prepared by wet and dry phase inversion techniques. The reference discloses a catalytic blend of poly(vinylidene fluoride), and carbon black for preparing the gas diffusion. The reference discloses that the catalytic blend can further contain N,N-dimethyl formamide. It further discloses that the gas diffusion electrode is prepared by casting the blend with a doctor's knife onto a carbon substrate to form a film and coagulating the film in a coagulation liquid. The reference discloses in examples 1 and 4, a catalytic blend containing carbon black PVF and DMF used to cast a film on a carbon cloth substrate. The film is then coagulated and dried to make a gas diffusion electrode. It is described in Example 1 that the electrode is then painted with a catalyst layer ink containing polyvinylidene fluoride, propanol, water and Pt on Vulcan VX-72. Example 2 describes that a catalytic blend containing Acetylene Black C-100 carbon, DMF and PVF is applied to a carbon cloth substrate. Example 3 describes a gas diffusion electrode made by casting a film of catalytic blend containing Pt on activated charcoal, DMF and PVF on to a carbon cloth substrate. The example further describes coagulating and drying the film. Example 5 describes that the coagulated film is cast on to a carbon cloth substrate with a layer of ink

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containing Pt on Vulcan VX-72, DMF and polysulfone. Example 6 describes a gas diffusion electrode made by a process similar to Example 3 and further discloses poly(vinylpyrrolidone) as a pore filter to control the porosity of the gas diffusion layer. Example 7 describes preparation of two gas diffusion electrodes by the process of Example 1, using two different coagulation liquids and casting on a carbon substrate. Nowhere in the reference is it disclosed that a catalyst ink is applied to a PSSA-PVDF membrane as required in step (b) of the instantly claimed process.

Differences between the claimed subject matter and the disclosure of Cabasso *et al.*

Cabasso *et al.* does not disclose a process for making a membrane electrode assembly for a fuel cell wherein a catalyst ink is applied to at least one side of a PSSA-PVDF membrane and the membrane is bonded to at least one electrode. The reference does not disclose that catalyst ink is applied to a PSSA-PVDF membrane.

The reference discloses that the gas diffusion electrode is prepared by using a catalytic blend. It is disclosed that catalyst ink is applied to the electrode. The reference further discloses that the electrode is bonded to a NAFION membrane (column 10, lines 26-30). The reference does not disclose that a catalyst ink is applied to the membrane as required in step (b) of the instantly claimed process.

Thus, Cabasso *et al.* does not disclose every element of claim 19. Because Cabasso *et al.* does not disclose every element of claim 19, Cabasso *et al.* does not anticipate claim 19. Because claims 20-22 and 25 depend from claim 19, Cabasso *et al.* does not anticipate any of the claims dependent on claim 19. Applicant respectfully requests that the rejection be reconsidered and withdrawn.

REJECTION OF CLAIMS 13 AND 28 UNDER 35 U.S.C. §103(a)

The Office Action maintains the rejection of claim 13 and 28 as being obvious over Cabasso *et al.* as applied to claims 6, 8, 9, 11, 12, 14, 15, 17-22, 25 and 26, in view of Scherer *et al.* (U.S. Patent No. 5,656,386). Without conceding to the propriety of the rejection, claims 13 and 28 have been cancelled to advance prosecution of the application.

Applicant further submits that Scherer *et al.* teaches membranes containing a base polymer radiation-grafted with terminally sulphonated vinyl radicals. The reference teaches that the base polymer is selected from the group formed by substituted and unsubstituted polyolefins, substituted and unsubstituted vinyl polymers and their copolymers and the vinyl radicals are

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derived from vinyl monomers which are selected from the group formed by substituted and unsubstituted vinyl monomers. The reference further teaches that the base polymer is a polyolefin selected from the group formed by polyethylene, polypropylene, poly(tetrafluoroethylene), copolymer of poly(tetrafluoroethylene) and polyethylene, and copolymer of poly(tetrafluoroethylene) and poly(hexafluoropropylene) or a vinyl polymer selected from the group formed by poly(vinyl fluoride), poly(vinyl chloride) and poly(vinylidene difluoride), while the vinyl monomer is preferably selected from the group formed by styrene, α -fluorostyrene, α -methylstyrene and p-chloromethylstyrene. The reference does not teach or suggest a PSSA-PVDF membrane of the instant claims.

THE REJECTION OF CLAIM 26 UNDER 35 U.S.C. §102(e), OR UNDER 35 U.S.C. §103(a)

The Office Action alleges that claim 26 is a product-by-process claim and the fuel cell in the claim allegedly appears to be the same or similar to the prior art fuel cell insofar as the catalyst ink is applied to the membrane and the membrane is bonded to the electrode by hot-pressing. It is further alleged that in the event that any differences can be shown by the product of the product-by-process claim 26, such differences would have been obvious to the skilled artisan as a routine modification of the product.

Claim 26

Claim 26 is an independent claim and recites:

A fuel cell comprising a membrane electrode assembly, wherein the membrane electrode assembly is made by the process of:

- (a) providing a catalyst ink comprising a catalytic material, and poly(vinylidene fluoride);
- (b) applying the catalyst ink to at least one side of a PSSA-PVDF membrane;
- and
- (c) bonding the membrane to at least one electrode.

Disclosure of Cabasso *et al.*

As discussed above.

Rejection Under 35 U.S.C. §102(e)

Relevant Law

As discussed above.

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**Differences between the claimed subject matter and the disclosure of
Cabasso *et al.***

Cabasso *et al.* does not disclose a fuel cell containing a membrane electrode assembly wherein the membrane electrode assembly is made by a process that involves applying a catalyst ink to at least one side of a PSSA-PVDF membrane and bonding the membrane to at least one electrode. The reference does not disclose that catalyst ink is applied to a PSSA-PVDF membrane.

As discussed above, the reference describes that a catalyst ink is applied to the electrode. The reference discloses that the electrode is bonded to a NAFION membrane (column 10, lines 26-30). The reference does not disclose that a catalyst ink is applied to the PSSA-PVDF membrane as required in the instantly claimed fuel cell.

Thus, Cabasso *et al.* does not disclose every element of claim 26. Because Cabasso *et al.* does not disclose every element of claim 26, Cabasso *et al.* does not anticipate claim 26. Applicant respectfully requests that the rejection be reconsidered and withdrawn.

Rejection Under 35 U.S.C. §103(a)

Relevant Law

[I]n order to establish a *prima facie* case of obviousness, there must be evidence, preferably a teaching, suggestion, incentive or inference from the cited art or in the form of generally available knowledge that one of ordinary skill would have been led to modify the relevant teaching to arrive at what is claimed. *In re Papesch*, 315 F.2d 381, 391, 137 USPQ 43, 51 (CCPA 1963).

The prior art must provide a motivation whereby one of ordinary skill in the art would have been led to do that which the applicant has done. *Stratoflex Inc. v Aeroquip Corp.*, 713 F.2d 1530, 1535, 218 USPQ 871, 876 (Fed. Cir. 1983). In addition, the mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggests the desirability of the modification. *In re Fritch*, 23 USPQ 1783 (Fed. Cir. 1992).

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Differences between the claimed subject matter and the teaching of Cabasso *et al.*

Applicant respectfully submits that Cabasso *et al.* does not teach or suggest applying a catalyst ink to at least one side of a PSSA-PVDF membrane and bonding the membrane to at least one electrode. The reference does not teach or suggest that catalyst ink is applied to a PSSA-PVDF membrane.

As discussed above, the reference teaches that a gas diffusion electrode is prepared by applying a catalytic blend to a substrate. It further teaches suitable substrates for the catalytic blend as carbon substrates including carbon paper, carbon cloth, carbon felt and carbon tape. It does not teach that a PSSA-PVDF membrane can be used as a substrate. The reference teaches that the electrode is bonded to a NAFION membrane (column 10, lines 26-30) to make a membrane electrode assembly for a fuel cell. There is no teaching or suggestion in the reference for applying a catalyst ink to a PSSA-PVDF membrane as required in the instantly claimed fuel cell.

Nowhere in the art is it suggested to add PVDF not only to the membrane, but also to the ink that is used to apply on the membrane. In fact, those having ordinary skill in the art would have believed that it was not necessary to add PVDF to a membrane that already included PVDF. This would have seemed to be superfluous, and there is no teaching or suggestion in the art for this dual operation. The art teaches adding PVDF to the ink, not to the membrane and the ink. Absent such teaching or suggestion, it would not be obvious to one of skill in the art to apply a catalyst ink to a PSSA-PVDF membrane.

THE REJECTION OF CLAIMS 27, 29 AND 30 UNDER 35 U.S.C. §102(e)

The Office Action alleges that claims 27, 29 and 30 are rejected for the same reasons as set forth for claims 11, 12, 14, 15, 17, 19-22 and 25. The Office Action alleges that Cabasso *et al.* discloses that the catalyst ink is applied to a membrane because the carbon paper disclosed in Cabasso *et al.* is considered to be readable on a membrane. Applicant respectfully traverses the rejection.

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Instant claims

Amended claim 27 is an independent claim and recite:

A process for making an electrode for a fuel cell, comprising:

- (a) providing a catalyst ink comprising a catalytic material, and poly(vinylidene fluoride); and
- (b) applying the catalyst ink to at least one side of a PSSA-PVDF membrane.

Claims 29 and 30 depend from claim 27 and further define the process.

Relevant Law

As discussed above.

Disclosure of Cabasso *et al.*

As discussed above.

Differences between the claimed subject matter and the disclosure of Cabasso *et al.*

Cabasso *et al.* does not disclose a step of applying the catalyst ink to at least one side of a PSSA-PVDF membrane as claimed in amended claim 27. The reference discloses that the gas diffusion electrode is prepared by applying a catalytic blend onto a substrate. It discloses suitable substrates for catalytic blend as carbon substrates including carbon paper, carbon cloth, carbon felt and carbon tape. It is further disclosed that the gas diffusion electrode that contains the catalyst ink is applied to a Nafion membrane via hot-pressing. The reference does not disclose a step of applying catalyst ink to a PSSA-PVDF membrane as required in the instantly claimed process.

Thus, Cabasso *et al.* does not disclose every element of claim 27. Because Cabasso *et al.* does not disclose every element of claim 27, Cabasso *et al.* does not anticipate claim 27. Because claims 29-30 depend from claim 27, Cabasso *et al.* does not anticipate any of the claims dependent on claim 27. Applicant respectfully requests that the rejection be reconsidered and withdrawn.

Rebuttal to Examiner's Argument

The Office Action alleges with respect to claims 27, 29 and 30, that the carbon paper disclosed in Cabasso *et al.* is considered to be readable on a membrane. Therefore, the reference discloses applying catalyst ink to a membrane. Applicant disagrees.

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Applicant respectfully submits that the reference discloses applying the catalytic to a carbon substrate. It discloses suitable substrates for catalytic blend as carbon substrates including carbon paper, carbon cloth, carbon felt and carbon tape. The reference discloses applying catalyst ink to gas diffusion electrode. The carbon paper disclosed in Cabasso *et al.* does not read on the PSSA-PVDF membrane in the instantly claimed process.

REJECTION OF CLAIMS 16, 24 and 31 UNDER 35 U.S.C. §103(a)

The Office Action rejects claims 16, 24 and 31 as being obvious over Cabasso *et al.* applied to claims 11, 12, 14, 15, 17, 19-22, 25, 27, 29 and 30 above, in view of Lawrance *et al.* The Office Action alleges that Cabasso *et al.* does not explicitly teach roughening the surface of the membrane prior to applying the catalyst ink, however Lawrance *et al.* teach such a roughening step. The Office Action maintains that a skilled artisan would have found the roughening step obvious for reasons such as increasing the surface area of the membrane. The Office Action further alleges that a roughening step would be an obvious modification motivated by the enhanced bonding of the catalysts to the membrane support as roughening provides for locking, uniting and fixing of the catalyst particles on the membrane surface.

This rejection is respectfully traversed. Applicant further submits that the rejection is also traversed with respect to new claim 31.

Relevant Law

In order to set forth a *prima facie* case of obviousness under 35 U.S.C. §103: (1) there must be some teaching, suggestion or incentive supporting the combination of cited references to produce the claimed invention (*ACS Hospital Systems, Inc. v. Montefiore Hospital*, 732 F.2d 1572, 1577, 221 USPQ 329, 933 (Fed. Cir. 1984)) and (2) the combination of the cited references must actually teach or suggest the claimed invention. Further, that which is within the capabilities of one skilled in the art is not synonymous with that which is obvious. *Ex parte Gerlach*, 212 USPQ 471 (Bd. APP. 1980). Obviousness is tested by "what the combined teachings of the references would have suggested to those of ordinary skill in the art." *In re Keller*, 642 F.2d 413, 425, 208 USPQ 871, 881 (CCPA 1981), but it cannot be established by combining the teachings of the prior art to produce the claimed subject matter, absent some teaching or suggestion supporting the combination (*ACS Hosp. Systems, Inc. v. Montefiore Hosp.* 732 F.2d 1572, 1577, 221 USPQ 329, 933 (Fed. Cir. 1984)). "To imbue one of ordinary skill in

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the art with knowledge of the invention in suit, when no prior art reference or references of record convey or suggest that knowledge, is to fall victim to the insidious effect of a hindsight syndrome wherein that which only the inventor taught is used against its teacher" *W.L. Gore & Associates, Inc. v. Garlock Inc.*, 721 F.2d 1540, 1553, 220 USPQ 303, 312-13 (Fed. Cir. 1983).

The instant claims

Claim 16

Applicant notes that claim 16 is canceled herein, thereby rendering the rejection moot.

Claims 24 and 31

Claim 24 depends from claim 19 and further defines the process of claim 19 as containing the step of roughening a surface of the membrane prior to applying the catalyst ink. Claim 19 is directed to making a membrane electrode assembly for a fuel cell, as discussed above.

Claim 31 depends from claim 27 and further defines the process of claim 27 as containing the step of roughening a surface of the membrane prior to applying the catalyst ink. Claim 27 is directed to making an electrode for a fuel cell, as discussed above.

The teachings of Cabasso *et al.*

As discussed above.

The teachings of Lawrance *et al.*

Lawrance *et al.* teaches method of method of making solid polymer electrolyte catalytic electrodes. The reference teaches that the method involves roughening the surface of the solid polymer electrolyte and depositing catalyst particles on the roughened surface. The reference teaches use of the polymer electrolyte membranes containing sulfonated perfluorocarbon and membranes containing copolymer of polytetrafluoroethylene in the methods taught therein. Further, the reference teaches that the catalyst materials are deposited or placed upon the surface of a roughened membrane in the dry or free flowing form of finely-divided particles or powders.

The reference does not teach or suggest a catalyst ink containing a catalytic material, and poly(vinylidene fluoride). Nor does it teach or suggest applying the catalyst ink to at least one side of a PSSA-PVDF membrane as required in the instant claims.

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Analysis

The Examiner has failed to set forth a prima facie case of obviousness

The Office Action alleges that a skilled artisan would find a step of roughening obvious for reasons such as increasing the surface area of the membrane, in view of Lawrance *et al.* a roughening step would be an obvious modification motivated by the enhanced bonding of the catalysts to the membrane support as roughening provides for locking, uniting and fixing of the catalyst particles on the membrane surface.

None of the cited references, singly or in any combination thereof, teaches or suggests the process of independent claims 19 or 27 because they do not teach or suggest the step of applying the catalyst ink to at least one side of a PSSA-PVDF membrane. Therefore, they can not teach or suggest the process of dependent claims 24 or 31.

The combination of teachings of the cited references does not result in the instantly claimed process

Furthermore, absent hindsight reconstruction, the combination of teachings of the references does not result in the presently claimed process that involves the step of providing a catalyst ink containing a catalytic material, and poly(vinylidene fluoride), the step of applying the catalyst ink to at least one side of a PSSA-PVDF membrane and the step of roughening a surface of the membrane prior to applying the catalyst ink. As noted above, Cabasso *et al.* teaches applying a catalytic blend of poly(vinylidene fluoride), and carbon black on to carbon substrates. The reference does not teach applying the ink to a PSSA-PVDF membrane. Lawrance *et al.* teaches applying catalyst materials in the dry or free flowing form of finely-divided particles or powders to the surface of a roughened membrane containing sulfonated perfluorocarbon and membranes containing copolymer of polytetrafluoroethylene.

Neither reference teaches or suggests the step of applying the catalyst ink containing a catalytic material, and poly(vinylidene fluoride) to at least one side of a PSSA-PVDF. There is no teaching in any of the references that would have suggested the use of a catalyst ink containing a catalytic material, and poly(vinylidene fluoride) with a PSSA-PVDF membrane. Therefore, the combination of references would not have resulted in the instantly claimed processes.

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Applicant further submits that nowhere in the art is it suggested to add PVDF not only to the membrane, but also to the ink that is used to apply on the membrane. Applicant respectfully submits that those having ordinary skill in the art would have believed that it was not necessary to add PVDF to a membrane that already included PVDF. This would have seemed to be superfluous, and there is no teaching or suggestion in the cited references for this dual operation. Thus, it would not be obvious to one of ordinary skill in the art to use a catalyst ink containing a catalytic material, and poly(vinylidene fluoride) with a PSSA-PVDF membrane.

* * *


In view of the amendments and remarks herein, reconsideration and allowance of the application are respectfully requested.

There is no fee required to file this Amendment in the above application. However, if any fees do apply, please charge them to, or apply any credits to Deposit Account 06-1050.

Respectfully submitted,

Date: _____

10/27/04


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